US Army Corps of Engineers®

One Team: Relevant, Ready, Responsive, Reliable

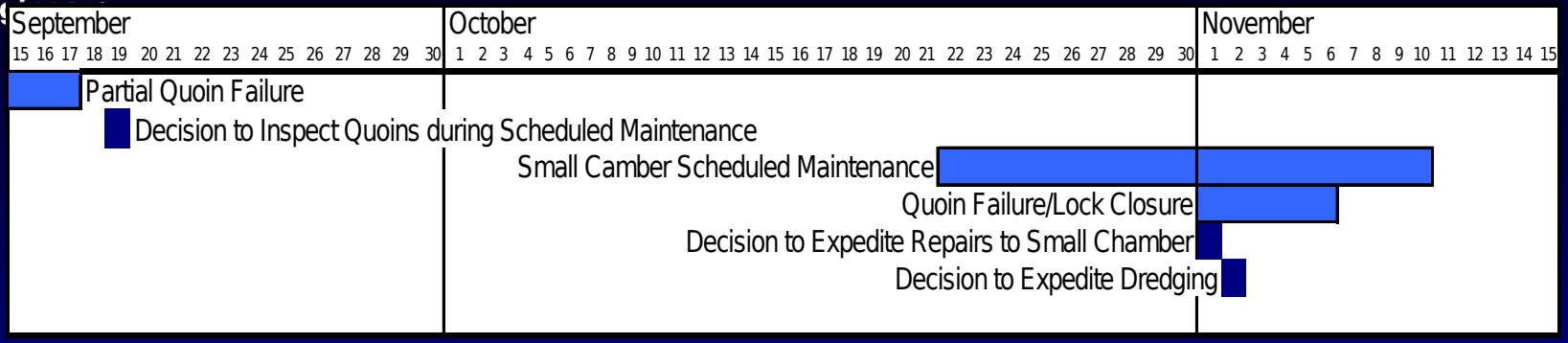
Pittsburgh District

Hannibal L/D Ohio River - Quoin Block Failure
110-ft x 1200-ft Main Lock Sep & Nov 2005

Hannibal L/D OR Quoin Block Failure

- What Happened
- Emergency Repairs
- Why It Happened
- Economic Impacts
- Future Preventative Action

A Time Line of What Happened


September
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
October
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
November
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Partial Quoin Failure
Decision to Inspect Quoins during Scheduled Maintenance
Small Camber Scheduled Maintenance
Quoin Failure/Lock Closure
Decision to Expedite Repairs to Small Chamber
Decision to Expedite Dredging

15 Sep – Partial quoin block failure at Hannibal DSRW Gate, Main Lock. Repair Fleet working on Pike Island dam gates sent small crew to execute immediate remedial repairs. Scheduled major maint. job for Oct/Nov at Hannibal (nav notice sent out and coordination complete with industry) – added to scope of work to perform full inspection and assessment of main lock quoins at that time.

Mid Oct – Fleet at Hannibal to do scheduled Tainter Valve replacement in Aux Lock

Decision made to complete aux chamber valve work first – wanted good small chamber before "digging" into issue with large chamber. Also dredging issues downstream from small chamber.

1 Nov – Significant quoin block failure on large chamber

Need to complete valve work on small chamber started a week earlier, work was 60% complete.

Need to expedite dredging to clear year old shoaling issue downstream

First Quoin Block Failure

DSRW GATE 15 Sep 05

Approx 10-ft Length

First Emergency Repair

DSRW GATE 15-16 Sep 05

Hannibal L/D OR - Valve Repair

Scheduled 24 Oct -9 Nov 2006

- Replace Land Wall Emptying Valve and operating machinery in 110’x600’ Aux Lock
- Aux Lock Closed (14 work days, 18 day closure)
- Work Status - 1 Nov 05, (8 Days into scheduled work period) all machinery & old tainter valve was removed, boring eyes on trunnion beam, past the point of no return to reinstall old valve

LWEV Tainter Valve Replacement

- **LWEV replacement work expedited, Completed 6 Nov 05 , (4 days ahead of orig sched), Aux lock also reopened to Navigation 6 Nov 05**
- **After Aux Lock reopening lock crews locked approx. 12-15 Lockages/day. 39-tows waiting when Aux lock reopened**
- **110'x 1200' Main Lock reopened to navigation 15 Nov 05. Queue at reopening was approx 55.5-hrs**

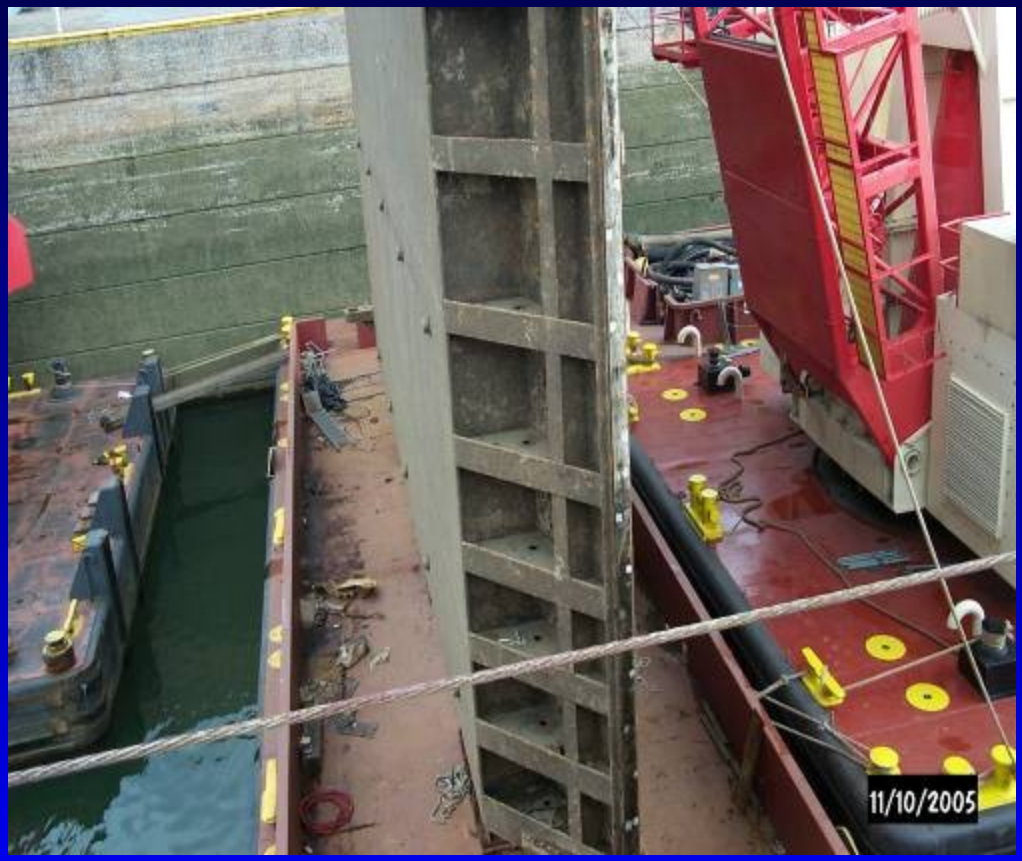
Second Quoin Block Failure

USRW GATE 1 Nov 05

Appox. 20-ft

Second Emergency Repair

USRW GATE 1- 15 Nov 05



Second Emergency Repair

Inspect & Pinning Other Gates
1 - 15 Nov 05

IMPACTS

- **Unscheduled 6-day Total Closure of the Ohio River at mile 126.4**
- **$500K Direct Impacts to Pittsburgh District**
  - Includes extra labor hours for the repair crew & at the lock; additional cost for accelerating dredging contract; cost of materials; cost to replace equipment damaged during repairs
  - Estimated five fold increase in costs
- **$3.4M Delay Costs to Tows**
  - Delay cost of $478/hour/tow
  - 130 tows were impacted an average delay time of 55 hours
- **~$5M Other Impacts to Ind**
  - Includes cost to industry for using alternate sources of transportation; decreasing production, lost sales, burning-up stockpiles, lost revenue, and other factors

Total Cost of Closure: ~$9M

Why It Happened

Direct Causes

- Bolt failure
- Quoin block backing material deterioration (epoxy vs zinc)

Indirect Causes

- Component age
- Design limits ability to readily observing deterioration
- Design limits ease of maintenance
- Inspection intervals unclear or not efficiently tracked
- Schedule constraints and work flow efficiencies
- Previous dewatering not focused on quoin

Why It Happened – AAR Analysis

Summary of Contributing Factors

- Resources
  - People
    - Loss/Reorganization of Maintenance Capability – Lock Maintenance Personnel doing Lock Operations 40-60% of Time
    - Loss/Reorganization of Inspection Engineering Capability – Shortage/Lack of Training in Inspection & Maintenance
      - 1st Shop – Local Maintenance & Inspection
      - 2nd Shop – Maintenance Standards/Inspection & Repair Party
      - 3rd Shop – Major Rehabilitation
    - Lack of Consistent Method to Prioritize Level of Work - typically left to branch level and below - No Condition Indexing
    - Loss of Capability to Generate Scope/Work Packages & Cost Estimates
    - Loss of Institutional Knowledge – Maintenance History/Efficiency
  - Funding
    - Prioritization of Need 2 Years Out
    - Limited Flexibility – by appropriation, not necessarily tied to need
  - Tools
    - Lack of Contracting Tools to Leverage Existing Workforce

Why It Happened - AAR Analysis

Summary of Contributing Factors (Cont.)

- Process
  - Inspection Program
    - Inconsistent/not formalized due to constraints
    - Diving program key but constrained – High Risk, prioritization of workload
  - Maintenance Standards
    - Manufacturer/design standards
    - Tracking mechanisms
  - Maintenance Scheduling
  - Maintenance Programming/Funding

- Design/Construction Issues
  - Design Issues
    - Original Design
    - Local & Regional Fixes
    - Sharing of fixes?
  - Construction

Future Actions

- Short Term Solutions
  - Inspect all other like design quoin seals in District
  - Check historic repair records for completed quoin/miter repairs
  - Schedule Hannibal 110’ x 1200’ Lock Dewatering for FY07 for full fix

- Long Term Solutions
  - Incorporate LRD Maintenance Standard
  - Resources issues - Seek to better balance existing resources first, re-educate staff
  - Process changes - dive program, inspection & condition assessment program and reporting
  - Design/Construction changes - regional approaches
  - Focus on highest impact projects first
  - Refine Program - Comprehensive, but not complicated or resource intensive program

Things that Enhanced Success

- Public Affairs person on site to handle media with designated media POC.
- Extra safety inspection personnel.
- Industry representative on site until lockage process is setup and functioning – need 24-hr POC with industry
- Set up command center at site
- Repair Fleet on site when failure occurred
- Stock inventory of replacement parts
- Plant capacity to handle the work load

Questions?